**ESR6**

**Project title:** Automated bucket filling for wheel loaders using machine learning techniques.

**Place of employment and planned mobility**: Karlsruhe Institute of Technology, Germany: 9 months, Liebherr-Werk Bischofshofen GmbH, Austria: 21 months, John Deere Forestry Oy, Finland: 6 months

**Supervisory team**: Dr. Manuel Boes (Liebherr) & Prof. Marcus Geimer (KIT)

**Project tasks and objectives:** During the work cycle of a wheel loader, filling the bucket with bulk material is the most demanding task for the operator. At the same time, it is in this phase of the cycle where most of the total fuel is consumed by the machine. Each bulk material, such as sand, gravel, coal or blasted rock, needs a different approach for optimized bucket filling, which again needs to be adapted to the material's properties, such as moisture content, density or particle size distribution. The human operator typically adapts automatically to these requirements and builds up experience on how to handle different bulk materials over time.

The work includes:

- Literature research (e.g. bucket filling techniques, state of the art in automation of this subtask)
- Studying the bucket filling process today as it is performed by human operators
- Devising target functions for optimized bucket filling (e.g. filling factor, time, fuel consumption, …)
- Modelling the bucket filling process in a simulation environment (coupled DEM-MBD or similar), to be able to later compare different automation approaches
- Validation of the models using measurements
- Research into adequate machine learning approaches (supervised, reinforcement learning) suitable to automate the process
- Implementation of different approaches, training using simulated or real data
- Investigating the relevance of different available sensor inputs
- Benchmarking the different approaches, quantification (reference: human operator's performance)
- Derive concepts on how to automatically adapt to changing material properties over multiple work cycles
- Transfer of the results onto a real machine for actual tests after successful simulations

The ESR will also be involved in dissemination through social media promotion of the network, such as Webropol surveys, and LinkedIn groups, YouTube video channels, Twitter and blogging.

**Starting date:** January 1st, 2020. Negotiable.

**Duration of the work contract:** 36 months/full-time contract

**Trial period:** 6 months

**Target degree:** PhD degree from Karlsruhe Institute of Technology, Germany

**Approximate gross salary**: about 3600 EUR/month plus family allowance if applicable

**Eligibility:** ESR shall at the date of recruitment, be in the first four years (full-time equivalent research experience) of their research careers and have not been awarded a doctoral degree. The researcher must not have resided or carried out his/her main activity (work, studies, etc) in the country of his/her first employer (Karlsruhe Institute of Technology, Germany) for more than 12 months in the 3 years immediately prior to his/her recruitment.

The applicant must be in possession of Master of Science (MSc) diploma in Mechanical Engineering, Mechatronics, Machine Learning, Data Science, Robotics and Automation or similar.

**English language requirements**: Proficiency in written/spoken English is mandatory. A proof is desired, such as an English certificate of level B2.

## Application

**Closing dat**e: 13.11.2019

The applicant must submit the following documents through [LAURA portal](), only a clear copy of the documents will be considered

1. **Certified copies of the bachelor's and master's degree certificates with the Diploma Supplement (DS)** as approved by the EU Commission for degrees completed in European universities (when applicable) Official translations into English (if the original documents are in a language other than English)
2. **Curriculum Vitae/CV** (preferably in Europass format)
3. **List of publications (if any),** your contributions in the publication
4. **References:** Contact details of 2 or more referees included in the CV
5. **Motivation letter: maximum** 1 page where you introduce yourself and present your qualifications; you may include also your previous research fields and main research results. Please emphasize your future goals career-wise
6. **Copy of the passport**
7. **Proof of residence:** statement and certificates/documents demonstrating your residence(s) in the last 4 years. [A template is available on the website under *How to Apply*]().

## Additional information

**Working and living conditions in Germany at Karlsruhe Institute of Technology** – Karlsruhe is located in the Southwest Germany. It is one hour away on a fast train from the city of Frankfurt and its international airport. Karlsruhe Institute of Technology (KIT) creates and imparts knowledge for the society and the environment as "The Research University in the Helmholtz Association". It is our objective to make significant contributions to global challenges in the fields of energy, mobility, and information. KIT prepares its 25.100 students for responsible tasks in society, industry, and science by offering research-based study programs. Read more [here](). The city of Karlsruhe is a very young and dynamic city with big ambitions and plans for the future. A huge variety of cultural offerings can be attended, through day as well as in the late hours.

**Working and living conditions in Austria at Liebherr** Situated about 45 minutes south of the city of Salzburg, Liebherr's Bischofshofen factory is the global competence centre for the group's wheel loaders. Surrounded by mountains of the Northern Limestone Alps, the site is specialised in the development, production and international marketing and sales of wheel loaders ranging from 4 t to well over 35 t gross weight - a product range of smart and efficient machines characterized by continuous innovation. The area offers a broad range of leisure activities in the mountains as well as cultural offerings in nearby Salzburg.

**Working and living conditions in Finland at John Deere Forestry** – Finland is among the most stable, free and safe countries in the world, based on prominent ratings by various agencies. It is also ranked as one of the top countries as far as social progress is concerned. John Deere Forestry is a world leading forest machinery company which develops and manufactures machines that are used for cut-to-length harvesting, loading and transporting the trees out of the forest. Advanced R&D focuses on leading edge technology development of machine automation and forest-site solutions.